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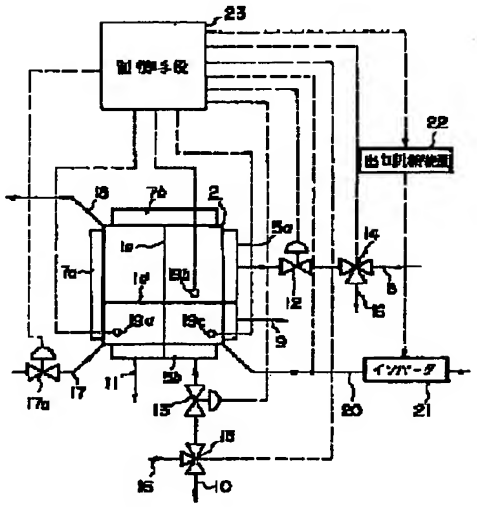
# (54) FUEL BATTERY POWER GENERATOR AND OPERATION METHOD THEREOF

(57) Abstract:

PROBLEM TO BE SOLVED: To restrict damage of a fuel battery laminated body to the minimum and try to ensure longer service life of the fuel battery laminated body.

SOLUTION: When at least one single battery of a single battery laminated body 2 is provided with at least one of DC detection means 19a, 19b, and 19c for detecting the current distribution in the plan direction of that single battery and this device is provided with a control means 23 for controlling the supply flow quantity and load current of reaction gas, this control means 23 compares the current distribution detected by means of the DC detection means 19a, 19b, and 19c with the allowance of the preset reference current. If the allowance is exceeded, at least one of the supply flow quantity of reaction gas to be supplied to the single battery laminated body 2 and a load current 20 is controlled.





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CLAIMS

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[Claim(s)]
[Claim 1] On both sides of an electrolyte layer, form a cell in inter-electrode [ of a pair ], and two or more laminatings of this cell are carried out. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. In this control means The current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand. The fuel cell power plant characterized by being constituted so that at least the supply flow rate of the reactant gas supplied to said cell layered product and one side of the load current may be controlled, when tolerance is crossed.
[Claim 2] The fuel cell power plant characterized by having the amperometry machine with which at least one direct-current detection means to detect the current distribution of the direction of a flat surface of a cell was arranged in the fuel cell power plant according to claim 1, and arranging this amperometry machine in at least one between a substack and a cooling plate.
[Claim 3] It is the fuel cell power plant characterized by being constituted so that a fuel cell may be stopped when the current distribution which detected the control means with the current detection means in the fuel cell power plant according to claim 1 is compared with the tolerance of the reference current set up beforehand and tolerance is crossed.
[Claim 4] The operating method of the fuel cell power plant characterized by suspending a fall or a change of load for a load current change rate when a current detection means detects the current of said cell and this detected current exceeds an allowed value by the transitional load process which starts a generation of electrical energy as compared with the allowed value of the reference current set up beforehand in the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current.
[Claim 5] The operating method of the fuel cell power plant characterized by halting a fall or the increment in the load current for the increment rate in the load current when a current detection means detects the current of said cell and this detected current exceeds an allowed value by the transitional load process which starts a generation of electrical energy as compared with the allowed value of the reference current set up beforehand in the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current.
[Claim 6] On both sides of an electrolyte layer, form a cell in inter-electrode [ of a pair ], and two or more laminatings of this cell are carried out. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. Two or more fixed resistance is allotted to juxtaposition, and the fixed-resistance circuit which

comes to connect a breaker at such fixed resistance, respectively is connected to said cell layered product. In said control means When the current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand in halt actuation and tolerance is crossed, by opening at least one of the breakers of said fixed-resistance circuit The fuel cell power plant characterized by being constituted so that the detected current may be controlled to tolerance.

[Claim 7] On both sides of an electrolyte layer, form a cell in inter-electrode [ of a pair ], and two or more laminatings of this cell are carried out. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means, and a variable-resistance circuit is connected to said cell layered product. In said control means In halt actuation, the current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand. The fuel cell power plant characterized by being constituted so that the current which resistance of said variable-resistance circuit was changed and was detected may be controlled to tolerance, when tolerance is crossed.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a fuel cell power plant and its operating method, especially detects current density distribution of the direction of a flat surface of the body of a fuel cell, and relates to the fuel cell power plant which protects the body of a fuel cell, and its operating method.
[0002]
[Description of the Prior Art] The fuel cell is known as equipment which transforms into direct electrical energy the chemical energy which a fuel has from the former. It is equipment constituted so that electrical energy might be taken out from inter-electrode [ of a top Norikazu pair ] using the electrochemical reaction produced at this time by contacting oxidant gas at the tooth back of the electrode of another side as reactant gas while inter-electrode [ of the pair which used the porosity nature ingredient ] pinches the matrix layer (electrolyte layer) of this fuel cell holding an electrolyte and the tooth back of one electrode generally contacts fuel gas to it as reactant gas. As the above-mentioned electrolyte, an acidic solution, a melting carbonate, an alkali solution, etc. are mentioned, and the phosphoric acid fuel cell with which current used the phosphoric acid is said to be the closest to utilization.
[0003] Drawing 8 is the decomposition perspective view showing the configuration of the phosphoric acid fuel cell which used the phosphoric acid as an electrolyte among this kind of fuel cells. As shown in drawing 8 , the cell layered product 2 to which it comes to carry out the laminating of two or more cells 1 for a generation of electrical energy through the gas division plate 3 is formed in the body of a fuel cell.
[0004] The cell 1 is constituted on both sides of matrix layer 1c into which anode electrode 1a of a pair and cathode electrode 1b which used the porosity nature ingredient sank the phosphoric acid. The catalyst by platinum etc. is applied to the field which counters with matrix layer 1c at the electrodes 1a and 1b of this pair, respectively. And while the fuel circulation slot where fuel gas, such as hydrogen, circulates is formed in the tooth back of anode electrode 1a, the oxidizer circulation slot where oxidant gas, such as oxygen, circulates is formed in the tooth back of cathode electrode 1b.
[0005] Such a cell 1 needs to remove and cool surplus heat at the time of operation, for example, needs to maintain it in constant temperature of about 200 degrees C. For this reason, the cell layered product 2 carries out the laminating of two or more cells 1, inserts the gas division plate 3 between each cell 1, respectively, forms one substack, carries out the laminating of two or more cooling plates 4 for discharging this subSUKUKKU and heat by turns, and is constituted.
[0006] In addition, the gas division plate 3 is constituted so that the electric contact between cells 1 may be secured, while classifying the reactant gas supplied to anode electrode 1a and cathode electrode 1b, respectively. Moreover, by pouring refrigerants, such as water, inside, the cooling plate 4 is constituted so that temperature control of the cell layered product 2 may be performed.
[0007] In the side face of such a cell layered product 2, the gas manifold 5 which supplies and discharges fuel gas and oxidant gas, respectively is arranged at the cell layered product 2. And in order to take out the current generated in the cell layered product 2 to the cell layered product 2, the collecting electrode plate 6 is arranged at the edge of the upper and lower sides.

[0008] In the phosphoric acid fuel cell which has the above configurations, the following reactions (dissociative reaction) start in each cell 1 according to an operation of the catalyst by which the hydrogen supplied to anode electrode 1a was applied to anode electrode 1a.
[0009]
[Equation 1] H2 ->2H++2e-[0010] The hydrogen ion (H+) generated by the dissociative reaction of this hydrogen moves in the inside of the phosphoric acid stored in matrix layer 1c, and reaches cathode electrode 1b. On the other hand, an electron (e-) flows an external circuit from anode electrode 1a, works through power loads (for example, an electric bulb, a motor, a heater, etc.), and reaches cathode electrode 1b. And the following reactions occur according to an operation of the catalyst applied to cathode electrode 1b with the hydrogen ion (H+) which has moved from anode electrode 1a, the oxygen (O2) supplied to cathode electrode 1b, and the electron (e-) which has worked in the external circuit.
[0011]
[Equation 2] 4H++O2 14e-->2H2 O [0012] Therefore, in a cell 1, while hydrogen oxidizes and water (H2 O) is generated, the chemical energy at this time turns into electrical energy given to external electric load. Thus, the overall reaction as a cell of a cell 1 is completed. In addition, although the reaction in the above-mentioned cell 1 turns into exothermic reaction, the heat generated here is cooled by the cooling plate 4 inserted in the cell layered product 2 interior.
[0013]
[Problem(s) to be Solved by the Invention] By the way, in order for a fuel cell to generate electricity, each reactant gas fully needs to be supplied to each electrodes 1a and 1b. However, when either of reactant gas also runs short to the electrical energy demanded, the following problems occur.
[0014] That is, when the oxidant gas flow rates supplied in cathode electrode 1b run short, oxidant gas does not spread round the cell layered product 2 whole, but it will concentrate on the neighborhood (oxidant gas inlet port) to which oxidant gas is supplied, and a reaction will increase compared with a condition with the normal calorific value of this part, for example. On the other hand, in the neighborhood (oxidant gas outlet) oxidant gas is discharged, supplying [ of oxidant gas ] becomes inadequate, and a reaction will seldom occur, but calorific value will fall compared with a normal condition.
[0015] Thus, if cathode electrode 1b becomes an elevated temperature by the temperature rise near an oxidant gas inlet port, evaporation of the phosphoric-acid electrolyte currently stored in the cell and degradation of a catalyst etc. will advance quickly, and will become the cause of shortening the life of a cell. Now, it becomes the failure of prolonged operation by which the fuel cell was stabilized.
[0016] Such a phenomenon happens similarly, when fuel gas runs short by anode electrode 1a. And near a fuel gas outlet, when lack of fuel gas is remarkable, since a hydrogen ion is not supplied to cathode electrode 1b, generation of water does not take place. And the following reactions which corrode the carbon which is the ingredient of an electrode and a cooling plate instead of generation of water occur.
[0017]
[Equation 3] C+2eta2 O->CO2+2H2[0018] If this reaction advances, a deficit will arise in the main components of a fuel cell, and operation of a fuel cell will become impossible.
[0019] Here, when the supply flow rates of fuel gas or oxidant gas run short, the amount of electrical energy falls. That is, the electrical potential difference generated in the cell layered product 2 will fall. Therefore, in order to prevent generating of the above abnormalities, the electrical potential difference of the cell layered product 2 is detected, and when it becomes below constant value with the electrical potential difference, the abnormality detection approach judged that abnormalities occurred in the fuel cell is learned for the conventional fuel cell.
[0020] However, by the abnormality detection approach by the electrical potential difference of such a cell layered product, it cannot specify whether the electrical potential difference fell with lack of the reactant gas of either fuel gas or oxidant gas. And since abnormalities are specified, when operation of a fuel cell is suspended, generation-of-electrical-energy dependability will fall sharply.
[0021] Therefore, when abnormalities occur, considering as a normal condition is desirable, continuing operation of a fuel cell. It can consider supplying both fuel gas and oxidant gas to a fuel

cell, and making both amounts of reactant gas increase to this. However, the reactant gas of the direction which was a supply flow rate normal at the time of an abnormal occurrence will be superfluously supplied in this case.
[0022] Moreover, it is thought that concentration of the current in such a direction of a flat surface and a temperature rise may happen also in the transitional condition (henceforth a load shift process) of introducing air into cathode electrode 1b from the condition of not generating electricity, and starting a generation of electrical energy with the rise of a stack electrical potential difference.
[0023] That is, at the time of un-generating electricity, anode electrode 1a and cathode electrode 1b are inert gas and usual [ N / 2 ]. It is filled with gas. From such a condition, if air is introduced into cathode electrode 1b, near an oxidant gas inlet port, an electrical potential difference will occur with the air which flowed. This electrical potential difference is detected as a stack electrical potential difference.
[0024] However, before fully permuting with air to near an oxidant gas outlet depending on the flow rate of the air which flowed, a stack electrical potential difference will reach the high voltage, and initiation, i.e., the load current, will flow a generation of electrical energy. Consequently, the load current will be generated in the part to which air was supplied enough. That is, it is possible that a current concentrates on an oxidant gas inlet-port part. When the hydrogen insufficient condition of anode electrode 1a occurs or a temperature rise happens by this current concentration, as mentioned above, the life of a fuel cell will be shortened.
[0025] Moreover, it is possible that the current concentration in transitional **** takes place similarly in the following halt actuation. That is, in order that the system which received halt operator command may remove reactant gas out of a cell, it is inert gas and usual [ N / 2 ]. Gas is supplied. In this case, the oxygen density of the direction of a flat surface of cathode electrode 1b falls gradually from an oxidant gas entrance side. On the other hand, a stack electrical potential difference will be generated if there is air. Therefore, it sets to halt actuation and is N2. A reaction occurs in the part in which the residual air extruded by gas exists. Especially, it is N2. It is thought that the degree of concentration (current density) rises as the interface of gas and residual air approaches an oxidant gas outlet side.
[0026] This invention was made in consideration of the situation mentioned above, and controls damage of a fuel cell layered product to the minimum, and it aims at offering the fuel cell power plant which can attain reinforcement of a fuel cell layered product, and its operating method.
[0027]
[Means for Solving the Problem] In order to solve the technical problem mentioned above, claim 1 of this invention On both sides of an electrolyte layer, form a cell in inter-electrode [ of a pair ], and two or more laminatings of this cell are carried out. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. In this control means When the current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand and tolerance is crossed, it is characterized by being constituted so that at least the supply flow rate of the reactant gas supplied to said cell layered product and one side of the load current may be controlled.
[0028] In a fuel cell power plant according to claim 1, claim 2 has the amperometry machine with which at least one direct-current detection means to detect the current distribution of the direction of a flat surface of a cell was arranged, and is characterized by arranging this amperometry machine in at least one between a substack and a cooling plate.
[0029] Claim 3 is characterized by constituting the control means so that a fuel cell may be stopped when the current distribution detected with the current detection means is compared with the tolerance of the reference current set up beforehand and tolerance is crossed in a fuel cell power plant according to claim 1.
[0030] In the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current, it is the transitional load

process which starts a generation of electrical energy, claim 4 detects the current of said cell with a current detection means, and when this detected current exceeds an allowed value as compared with the allowed value of the reference current set up beforehand, it is characterized by suspending a fall or a change of load for a load current change rate.
[0031] In the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current, it is the transitional load process which starts a generation of electrical energy, claim 5 detects the current of said cell with a current detection means, and when this detected current exceeds an allowed value as compared with the allowed value of the reference current set up beforehand, it is characterized by halting a fall or the increment in the load current for the increment rate in the load current.
[0032] Claim 6 forms a cell in inter-electrode [ of a pair ] on both sides of an electrolyte layer, and carries out two or more laminatings of this cell. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. Two or more fixed resistance is allotted to juxtaposition, and the fixed-resistance circuit which comes to connect a breaker at such fixed resistance, respectively is connected to said cell layered product. In said control means When the current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand in halt actuation and tolerance is crossed, by opening at least one of the breakers of said fixed-resistance circuit It is characterized by being constituted so that the detected current may be controlled to tolerance.
[0033] Claim 7 forms a cell in inter-electrode [ of a pair ] on both sides of an electrolyte layer, and carries out two or more laminatings of this cell. In the fuel cell power plant which inserts a gas division plate, respectively, forms a substack between each cell, carries out two or more laminatings of this substack and cooling plate by turns, and comes to form a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of said cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means, and a variable-resistance circuit is connected to said cell layered product. In said control means When the current distribution detected with said direct-current detection means is compared with the tolerance of the reference current set up beforehand in halt actuation and tolerance is crossed, resistance of said variable-resistance circuit is changed and it is characterized by being constituted so that the detected current may be controlled to tolerance.
[0034]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing.
[0035] Drawing 1 is the block diagram showing the phosphoric acid fuel cell of the return flow form which applied the 1st operation gestalt of the fuel cell power plant concerning this invention. In addition, the same sign is given to the same as that of the conventional technique shown in drawing 8 , or a corresponding part, and the explanation is omitted.
[0036] As shown in drawing 1 , while the fuel gas supply way 8 and the fuel gas exhaust passage 9 are connected through 1st gas manifold 5a, the oxidant gas supply way 10 and the oxidant gas exhaust passage 11 are connected to the cell layered product 2 through 2nd gas manifold 5b. The fuel gas which is each reactant gas, the fuel gas flow control valve 12 which adjusts the flow rate of oxidant gas, and the oxidant gas flow control valve 13 are installed in each supply ways 8 and 10.
[0037] Moreover, the inert gas supply pipe 16 is connected to each supply ways 8 and 10 through the fuel gas selector valve 14 and the oxidant gas selector valve 15, respectively. The fuel gas selector valve 14 and the oxidant gas selector valve 15 permute the reactant gas inside a fuel cell by inert gas, such as nitrogen gas, at the time of the storage at the time of the shipment from the works of a fuel cell, and the shutdown after local installation etc. Or it is prepared as this change means for permuting the inert gas in a fuel cell by reactant gas conversely at the time of operation of a fuel cell.

And the refrigerant circulation way 17 and the refrigerant exhaust passage 18 for circulating a refrigerant are connected to the cooling plate inserted between each substack at the cell layered product 2. Here, refrigerant lonely control valve 17a is prepared in the refrigerant circulation way 17.

[0038] In such a fuel cell, the return manifolds 7a and 7b are formed in the side face of each opposite side of the 1st and 2nd gas manifold 5a and 5b on both sides of the cell layered product 2 at each. Moreover, the racing stripes 1d and 1e under which it comes to lay each at least one slot by the matter of gas nonproliferation nature are formed in the reactant gas circulation slot of anode electrode 1a of each cell, and cathode electrode 1b. With these racing stripes 1d and 1e, after reactant gas passes through the supply way in a cell, it is constituted through each return manifold 7a and 7b so that it may be supplied in the cell of the exhaust passage again divided with the racing stripes 1d and 1e.
[0039] such a fuel cell power plant -- the cell 1 of the central approach of the substack of the center section of the cell layered product 2 -- respectively -- the 1- the 3rd current detection means 19a-19c is established. 1st current detection means 19a is in the cell which becomes near the return manifold 7a by the side of a fuel gas return trip, and is prepared in about 11 exhaust passage by the side of an oxidant gas outward trip.
[0040] Moreover, 2nd current detection means 19b is prepared in the location in the cell used as about [ which was established in the anode electrode in middle with racing stripe 1e prepared in the cathode electrode the supply way 8 side by the side of a fuel gas outward trip ] racing stripe 1d.
[0041] Furthermore, 3rd current detection means 19c is prepared in the part which is in the cell used as about nine exhaust passage by the side of a fuel gas return trip, and becomes about ten supply way by the side of an oxidant gas outward trip. The load current (direct current) 20 of a fuel cell is changed into an ac output by the inverter 21, and is supplied to an external load. This inverter 21 is controlled by the power control device 22.
[0042] the above-mentioned flow control valves 12 and 13, selector valves 14 and 15, and the 1- the 3rd current detection means 19a-19c, the monitor means (not shown) of the load current 20, and the power control device 22 are connected to the control means 23, respectively. Moreover, the inverter 21 is connected to the control means 23 through the power control device 22. the case where normal operation is carried out to this control means 23 -- the 1- the current (reference current) value which comes out, respectively and should be detected and its allowed value of the 3rd current detection means 19a-19c are set up beforehand, and are inputted.
[0043] and this control means 23 -- the 1- if the current detected by the 3rd current detection means 19a-19c is inputted, this current value, said reference current value, and tolerance are compared, and the condition of flow control valves 12 and 13 or selector valves 14 and 15 is changed by that result, or it is constituted so that the control signal of controlling the load current 20 may be outputted.
[0044] this -- the 1- when the current distribution detected with the 3rd current detection means 19a-19c is in the tolerance of the reference current beforehand inputted into the control means 23, it is constituted so that a control signal which maintains the condition in the time from a control means 23 to flow control valves 12 and 13 and selector valves 14 and 15 may be outputted.
[0045] On the other hand, when at least one allowed value of the current detected with the current detection means 19a-19c is exceeded, the control means 23 is constituted so that a control signal to which at least one or more conditions are changed among flow control valves 12 and 13 and selector valves 14 and 15 may be outputted.
[0046] by the way, the 1- when the current distribution detected with the 3rd current detection means 19a-19c was peculiar to the fuel cell, it changes so that it may describe in drawing 2 when the flow rate of fuel gas changes, and the flow rate of oxidant gas changes, changing, as shown in drawing 3 is beforehand checked by an observation or count. And this information is inputted into the control means 23. Furthermore, since current distribution changes as shown in drawing 4 also when the load current changes, it is inputted into the control means 23 also about this information.
[0047] and the above information -- being based -- a control means 23 -- the 1- fuel gas, oxidant gas, or lack and excess of the load current is judged from the current distribution detected with the 3rd current detection means 19a-19c, and it is constituted so that a control signal may be outputted.
[0048] Next, an operation of the 1st operation gestalt is explained.

[0049] In the fuel cell power plant constituted as mentioned above, when the current value detected with each current detection means 19a-19c changes to low current or a high current rather than the tolerance inputted into the control means 23 at least one, a control signal is sent out so that oxidant gas, fuel gas, or the load current may be in a normal condition, and at least one or more conditions may be changed from a control means 23 to flow control valves 12 and 13 and selector valves 14 and 15 inside.
[0050] Here, the current distribution detected with the current detection means 19a-19c can consider the six following kinds, lack and an excess are detected by the control means 23 about fuel gas, oxidant gas, and the load current, respectively, and a control signal is sent out.
[0051] (1) The current value of 2nd current detection means 19b is larger than the tolerance of reference current, and when the current value of other 1st [ the ] and the 3rd detection means is smaller than tolerance, as shown in drawing 2 , it can be judged as the condition that fuel gas ran short compared with the supply flow rate of forward always. The signal operated so that the opening may become large is outputted to the fuel gas flow control valve 12 of the fuel gas supply way 8, and the supply flow rate of fuel gas is made to increase to it by the control means 23 according to this.
[0052] (2) The current value of the 1st and 3rd current detection means 19a and 19c is in the tolerance of reference current, and when the current value of 2nd current detection means 19b is smaller than tolerance, it can be judged that fuel gas is superfluous compared with the supply flow rate of forward always as shown in drawing 2 . According to this, by the control means 23, the signal operated so that the opening may become small is outputted to the fuel gas flow control valve 12 of the fuel gas supply way 8, and the supply flow rate of fuel gas is decreased.
[0053] (3) The current value of 2nd current detection means 19b is larger than the tolerance of reference current, and the current value of 1st current detection means 19a is smaller than the tolerance of reference current, and when the current value of 3rd current detection means 19c is in the tolerance of reference current, as shown in drawing 3 , it can be judged as the condition that oxidant gas ran short compared with the supply flow rate of forward always. The signal operated so that the opening may become large is outputted to the oxidant gas flow control valve 13 of the oxidant gas supply way 10, and the supply flow rate of oxidant gas is made to increase to it by the control means 23 according to this.
[0054] (4) The current value of 1st current detection means 19a is larger than the tolerance of reference current, the current value of 2nd current detection means 19b is smaller than the tolerance of reference current, and when the current value of 3rd current detection means 19c is in the tolerance of reference current, as shown in drawing 3 , oxidant gas can judge it as a superfluous condition compared with the supply flow rate of forward always. According to this, by the control means 23, the signal operated so that the opening may become small is outputted to the oxidant gas flow control valve 13 of the oxidant gas supply way 10, and the supply flow rate of oxidant gas is decreased.
[0055] (5) The current value of the 2nd and 3rd current detection means 19b and 19c is smaller than the tolerance of reference current, and when the current value of 1st current detection means 19a is in the tolerance of reference current, as shown in drawing 4 , it can be judged as the condition that the load current is decreasing compared with always [ forward ]. This is too little [ the power demanded from a need side ] case. In this condition, fuel gas and oxidant gas will be supplied to the cell layered product 2 beyond the need, in a control means 23, the control signal operated so that each opening of flow control valves 12 and 13 may be made small is outputted, the supply flow rate of fuel gas and oxidant gas is decreased, and the amount of generations of electrical energy is reduced.
[0056] (6) The current value of the 2nd and 3rd current detection means 19b and 19c is larger than the tolerance of reference current, and when the current value of 1st current detection means 19a is in the tolerance of reference current, as shown in drawing 4 , it can be judged as the condition that the load current is increasing compared with always [ forward ]. This is the case that the power demanded from a need side is excessive. The bad influence which the cell layered product 2 will run short of fuel gas and oxidant gas, and it has on a cell in this condition is in the size case. In a control means 23, output the control signal operated so that each opening of flow control valves 12 and 13 may be enlarged, the supply flow rate of fuel gas and oxidant gas is made to increase, and the amount of generations of electrical energy is increased.

[0057] therefore, the fuel cell power plant of the 1st operation gestalt -- setting -- the 1- it can judge whether any of fuel gas and oxidant gas run short, or whether the load current's being excessive and the other abnormalities have arisen by comparing the current distribution detected with the 3rd current detection means 19a-19c with the tolerance of the reference current beforehand set as the control means 23.
[0058] And in a control means 23, by controlling a supply flow rate or more for at least one of fuel gas and oxidant gas, or controlling the load current 20 based on the result, degradation of a fuel cell can be prevented and it can consider as the outstanding fuel cell power plant which continues at a long period of time and can maintain the engine performance of a fuel cell.
[0059] thus -- according to the fuel cell power plant of the 1st operation gestalt -- the inside of the same cell -- the 1- by establishing the 3rd current detection means 19a-19c, three current distribution in a cell is detected and fuel gas, oxidant gas, and lack and excess of the load current can be judged by comparing the tolerance of reference current for such current distribution by the control means 23.
[0060] Moreover, it becomes possible by controlling fuel gas, oxidant gas, or the load current to prevent the temperature rise by lack of reactant gas and current concentration, and to prevent degradation of a fuel cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.
[0061] In addition, its effectiveness is the same, even if it is not necessary to necessarily install two or more current detection means 19a-19c which can be set in the 1st operation gestalt in the same cell, and it divides them into two or more cells and they detect a current value. Moreover, the number is not necessarily been plurality, either and there should just be at least one piece.
[0062] in addition, the 1st operation gestalt shown in drawing 1 -- setting -- the 1- when it changes into the condition of not corresponding to 6 kinds of decision bases (1) - (6) to the input signal of the 3rd current detection means 19a-19c, it is thought that the abnormalities except being expected have arisen. Continuing operation in this condition may have a bad influence on the cell layered product 2 or the generator machine connected to this, and it needs to stop a fuel cell.
[0063] Then, while outputting the signal which operates selector valves 14 and 15 from a control means 23 and intercepting a load circuit, supply of fuel gas and oxidant gas is suspended, inert gas is introduced into the cell layered product 2, and a generation of electrical energy is stopped.
[0064] namely, the control means 23 -- the 1- a fuel cell is stopped, when the current distribution detected with the 3rd current detection means 19a-19c is compared with the tolerance of the reference current set up beforehand and tolerance is crossed.
[0065] thus -- according to the fuel cell power plant of this operation gestalt -- the inside of the same cell -- the 1- by establishing the 3rd current detection means 19a-19c, three current distribution in a cell is detected and the abnormalities except being expected can be judged by comparing the current distribution and tolerance of reference current by the control means 23. And in order to control the effect on the generator machine connected to the cell layered product 2 and this, it becomes possible by stopping a fuel cell to prevent degradation of a fuel cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.
[0066] Next, 1 operation gestalt of the operating method of the fuel cell power plant concerning this invention is explained.
[0067] An oxygen density goes up gradually to an oxidant gas discharge side from the oxidant gas supply side from the condition that the cathode electrode is filled with the load shift process with nitrogen gas as the Prior art described. for this reason, the 1- shown in drawing 1 -- as for the current detected with the 3rd current detection means 19a-19c, a current will begin to flow in order of the current detection means 19c, 19b, and 19a. If it begins to take the load current, without fully supplying oxidant gas to a discharge side especially, a current concentrates on an oxidant gas supply side, and it is possible that temperature rises temporarily. According to this, by the control means 23, the control signal which makes an inverter 21 halt a fall or the increment in the load current 20 for the increment rate of the load current 20 is outputted, and current concentration is controlled.
[0068] namely, a load shift process -- setting -- a control means 23 -- the 1- when the current detected with the 3rd current detection means 19a-19c exceeds an allowed value as compared with the allowed value of the reference current set up beforehand, he is trying to halt a fall or the

increment in the load current for the increment rate in the load current
[0069] thus -- according to the fuel cell power plant of this example -- the inside of a cell -- the 1- by establishing the 3rd current detection means 19a-19c, three current distribution in a cell is detected and unusual concentration of a current can be detected by comparing the tolerance of the current and reference current by the control means 23. And it becomes possible by controlling the increment rate of the load current 20 to prevent unusual concentration of a current and to prevent degradation of a fuel cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.
[0070] in addition, the operating method of the above-mentioned operation gestalt -- setting -- a control means 23 -- a load process -- setting -- the 1- when the current detected with the 3rd current detection means 19a-19c exceeds an allowed value as compared with the allowed value of the reference current set up beforehand, you may make it suspend a fall or a change of load for a load current change rate Thereby, the same effectiveness as the operating method of the above-mentioned operation gestalt is acquired.
[0071] Drawing 5 is the decomposition perspective view showing the structure of the cell layered product of the phosphoric acid fuel cell which applied the 2nd operation gestalt of the fuel cell power plant concerning this invention. In addition, the sign same into a corresponding part identically to the conventional technique shown in drawing 8 is attached, and the explanation is omitted.
[0072] as shown in drawing 5 , between the cooling plates 4 of cell layered product 2a which touch the substack of a center section, and it mostly, it arranges so that the amperometry machine 24 may insert -- having -- this amperometry machine 24 -- that interior -- the 1- it has structure incorporating the 3rd current detection means 19a-19c.
[0073] By applying such cell layered product 2a to the configuration of the 1st operation gestalt shown in drawing 1 , an operation and effectiveness equivalent to the 1st operation gestalt can be acquired. Therefore, since the detail is as having mentioned above, it omits the explanation.
[0074] In addition, in the 2nd operation gestalt, the amperometry machine 24 should just also arrange at least one current detection means built into the interior that what is necessary is just to make it arranged in at least one between a substack and a cooling plate 4.
[0075] Drawing 6 is the block diagram showing the configuration of the phosphoric acid fuel cell of the return flow form which applied the 3rd operation gestalt of the fuel cell power plant concerning this invention. In addition, the same sign is attached about the same part as the part shown in drawing 1 , and the explanation is omitted. Suppose that it is the same also with the following operation gestalten.
[0076] As shown in drawing 6 , the fixed-resistance circuit 25 is connected to the cell layered product 2, fixed resistance 26a, 26b-26n is connected to juxtaposition, and, as for this fixed-resistance circuit 25, Breakers 27a, 27b-27n are connected to such fixed resistance 26a, 26b-26n, respectively.
[0077] a control means 23 -- halt actuation -- setting -- the 1- when the current distribution detected with the 3rd current detection means 19a-19c is compared with the tolerance of the reference current set up beforehand and tolerance is crossed, he is trying to control the detected current to tolerance breakers [ of the fixed-resistance circuit 25 / 27a, 27b-27n ] by opening at least one
[0078] By the way, as the Prior art described, in halt actuation, from the condition that air is supplied to the cathode electrode as oxidant gas, residual air is extruded from an oxidant gas supply side by nitrogen gas to an oxidant gas discharge side, and the oxygen density of an electrode surface falls.
[0079] for this reason, the 1- shown in drawing 6 -- both the currents detected with the 3rd current detection means 19a-19c are considered that a current will hardly flow in order of the current detection means 19c, 19b, and 19a at the same time they decrease.
[0080] On the other hand, since an electrical potential difference will be generated if air exists in the field of a certain amount of area, a stack electrical potential difference is generated also in the condition that the part into which a current does not flow partially is in a flat surface. The current decided by this stack electrical potential difference and fixed resistance [ 26a, 26b-26n ] resistance flows on a cell. consequently, current concentration -- it may be generated -- this -- the 1- it is detectable with the 3rd current detection means 19a-19c. According to this, by the control means 23, the control signal which opens at least one [ breakers / 27a, 27b-27n / which were connected to the

fixed-resistance circuit 25 ] or more is outputted, and a current is decreased.
[0081] thus -- according to the fuel cell power plant of the 3rd operation implementation gestalt -- the inside of a cell -- the 1- by establishing the 3rd current detection means 19a-19c, three currents in a cell are detected in halt actuation, and unusual concentration of a current can be detected by comparing the tolerance of the current and reference current by the control means 23. And it becomes possible to prevent unusual concentration of a current and to prevent degradation of a fuel cell by decreasing the current which opens at least one [ breakers / 27a, 27b-27n / of the fixed-resistance circuit 25 ] or more wide, and flows on a cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.
[0082] Drawing 7 is the block diagram showing the configuration of the phosphoric acid fuel cell of the return flow form which applied the 4th operation gestalt of the fuel cell power plant concerning this invention.
[0083] As shown in drawing 7 , the variable resistor 28 is connected to the cell layered product 2. a control means 23 -- halt actuation -- setting -- the 1- when the current distribution detected with the 3rd current detection means 19a-19c is compared with the tolerance of the reference current set up beforehand and tolerance is crossed, he changes the resistance of the variable-resistance circuit 28, and is trying to control the detected current to tolerance
[0084] By the way, as the Prior art described, in halt actuation, from the condition that air is supplied to the cathode electrode as oxidant gas, residual air is extruded from an oxidant gas supply side by nitrogen gas to an oxidant gas discharge side, and the oxygen density of an electrode surface falls. for this reason, the 1- shown in drawing 7 -- both the currents detected with the 3rd current detection means 19a-19c are considered that a current will hardly flow in order of the current detection means 19c, 19b, and 19a at the same time they decrease.
[0085] On the other hand, since an electrical potential difference will be generated if air exists in the field of a certain amount of area, a stack electrical potential difference is generated also in the condition that the part into which a current does not flow partially is in a flat surface. The current decided by this stack electrical potential difference and the resistance of variable resistance flows on a cell. consequently, current concentration -- it may be generated -- this -- the 1- it is detectable with the 3rd current detection means 19a-19c. According to this, by the control means 23, the control signal which enlarges resistance of a variable resistor 28 is outputted, and a current is decreased.
[0086] thus -- according to the fuel cell power plant of the 4th operation implementation gestalt -- the inside of a cell -- the 1- by establishing the 3rd current detection means 19a-19c, three currents in a cell are detected in halt actuation, and unusual concentration of a current can be detected by comparing the tolerance of the current and reference current by the control means 23. And it becomes possible to prevent unusual concentration of a current and to prevent degradation of a fuel cell by decreasing the current which enlarges the resistance of a variable resistor 28 and flows on a cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.
[0087]
[Effect of the Invention] As explained above, according to claim 1 of this invention, to at least one cell of a cell layered product At least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. In this control means The current distribution detected with the direct-current detection means is compared with the tolerance of the reference current set up beforehand. By constituting so that at least the supply flow rate of the reactant gas supplied to a cell layered product and one side of the load current may be controlled, when tolerance is crossed, and arranging at least one or more means to detect the current distribution of the direction of a flat surface of a cell By comparing with the tolerance of the current set up beforehand, fuel gas, oxidant gas, and lack and excess of the load current can be judged. By this performing control of a reactant gas flow rate, and control of the load current, degradation of a cell can be prevented and the fuel cell which can be operated for a long period of time can be offered.
[0088] According to claim 2, in a fuel cell power plant according to claim 1, it has the amperometry machine with which at least one direct-current detection means to detect the current distribution of

the direction of a flat surface of a cell was arranged, and the same effectiveness as claim 1 is acquired by having arranged this amperometry machine in at least one between a substack and a cooling plate.

[0089] According to claim 3, in a fuel cell power plant according to claim 1, when a control means compares the current distribution detected with the current detection means with the tolerance of the reference current set up beforehand and tolerance is crossed, the same effectiveness as claim 1 is acquired by being constituted so that a fuel cell may be stopped.

[0090] Therefore, in the fuel cell power plant of claim 1, claim 2, and claim 3, it can judge whether any of fuel gas and oxidant gas run short, or whether the load current's being excessive and the other abnormalities have arisen by comparing the current distribution detected with one piece or two or more current detection means with the tolerance of the reference current beforehand set as the control means. And in a control means, by controlling at least one or more of fuel gas and oxidant gas, or carrying out a protection halt of the cell based on the result, degradation of a cell can be prevented and it can consider as the outstanding fuel cell power plant which continues at a long period of time and can maintain the engine performance of a fuel cell.

[0091] According to claim 4, in the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current, by the transitional load process which starts a generation of electrical energy The local transient concentration in a cell flat surface can be prevented by a current detection means' detecting the current of a cell, and suspending a fall or a change of load for a load current change rate, when this detected current exceeds an allowed value as compared with the allowed value of the reference current set up beforehand. Consequently, degradation of a cell is prevented, it can continue and the engine performance of a fuel cell can be maintained at a long period of time.

[0092] According to claim 5, in the operating method of a fuel cell power plant which reactant gas is supplied [ operating method ] to the cell of a cell layered product, and generates the load current, by the transitional load process which starts a generation of electrical energy The same effectiveness as claim 4 is acquired by halting a fall or the increment in the load current for the increment rate in the load current, when a current detection means detects the current of a cell and this detected current exceeds an allowed value as compared with the allowed value of the reference current set up beforehand.

[0093] According to claim 6, at least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of a cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means. Two or more fixed resistance is allotted to juxtaposition, and the fixed-resistance circuit which comes to connect a breaker at such fixed resistance, respectively is connected to said cell layered product. In said control means When the current distribution detected with the direct-current detection means is compared with the tolerance of the reference current set up beforehand in halt actuation and tolerance is crossed, by opening at least one of the breakers of a fixed-resistance circuit By being constituted so that the detected current may be controlled to tolerance, it becomes possible to prevent unusual concentration of a current and to prevent degradation of a fuel cell. Therefore, it is stabilized and can consider as the fuel cell power plant in which prolonged operation is possible.

[0094] According to claim 7, at least one direct-current detection means to detect the current distribution of the direction of a flat surface of the cell to at least one cell of a cell layered product is arranged. The control means which controls the supply flow rate and the load current of reactant gas is connected to this current detection means, and a variable-resistance circuit is connected to a cell layered product. In a control means In halt actuation, the current distribution detected with the direct-current detection means is compared with the tolerance of the reference current set up beforehand. When tolerance is crossed, the same effectiveness as claim 6 is acquired by changing resistance of a variable-resistance circuit, and being constituted so that the detected current may be controlled to tolerance.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration of the phosphoric acid fuel cell of the return flow form which applied the 1st operation gestalt of the fuel cell power plant concerning this invention.
[Drawing 2] Drawing showing the relation between a fuel gas flow rate and the current within a cell flat surface.
[Drawing 3] Drawing showing the relation between an oxidant gas flow rate and the current within a cell flat surface.
[Drawing 4] Drawing showing the relation between the load current and the current within a cell flat surface.
[Drawing 5] The decomposition perspective view showing the structure of the cell layered product of the phosphoric acid fuel cell which applied the 2nd operation gestalt of the fuel cell power plant concerning this invention.
[Drawing 6] The block diagram showing the configuration of the phosphoric acid fuel cell of the return flow form which applied the 3rd operation gestalt of the fuel cell power plant concerning this invention.
[Drawing 7] The block diagram showing the configuration of the phosphoric acid fuel cell of the return flow form which applied the 4th operation gestalt of the fuel cell power plant concerning this invention.
[Drawing 8] The perspective view showing the configuration of the conventional phosphoric acid fuel cell.
[Description of Notations]
1 Cell
1a Anode electrode
1b Cathode electrode
1c Matrix layer (electrolyte layer)
1d Racing stripe
1e Racing stripe
2 Cell Layered Product
3 Gas Division Plate
4 Cooling Plate
5 Manifold
5a The 1st manifold
5b The 2nd manifold
6 Collecting Electrode Plate
7a Return manifold
7b Return manifold
8 Fuel Gas Supply Way
9 Fuel Gas Exhaust Passage
10 Oxidation Material Gas Supply Way
11 Oxidation Material Gas Exhaust Passage
12 Fuel Gas Flow Control Valve

13 Oxidation Material Quantity-of-Gas-Flow Control Valve
14 Fuel Gas Selector Valve
15 Oxidation Material Gas Selector Valve
16 Inert Gas Supply Pipe
17 Refrigerant Circulation Way
18 Refrigerant Exhaust Passage
19a The 1st current detection means
19b The 2nd current detection means
19c The 3rd current detection means
20 Load Current
21 Inverter
22 Power Control Device
23 Control Means
24 Amperometry Machine
25 Fixed-Resistance Circuit
26a, 26b-26n Fixed resistance
27a, 27b-27n Breaker
28 Variable Resistor

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[Translation done.]

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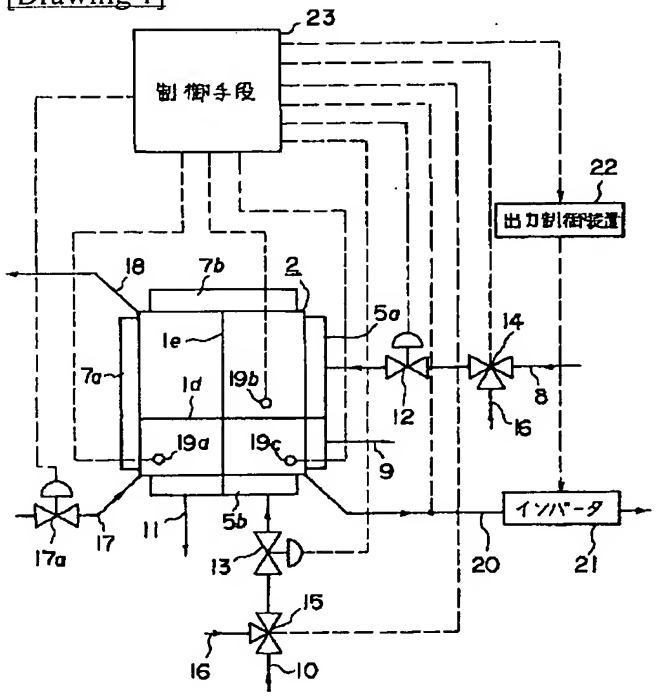
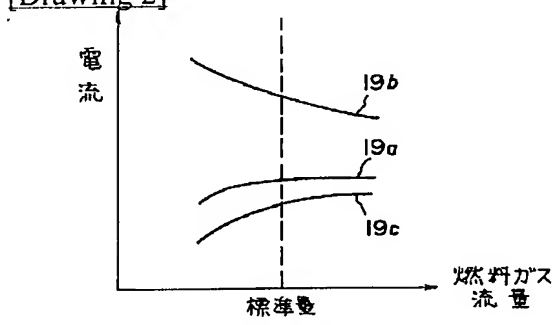
DRAWINGS

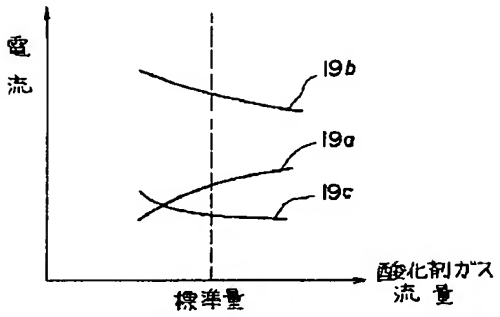
[Drawing 1]



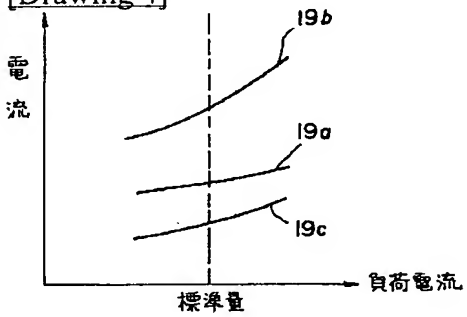

[Drawing 2]



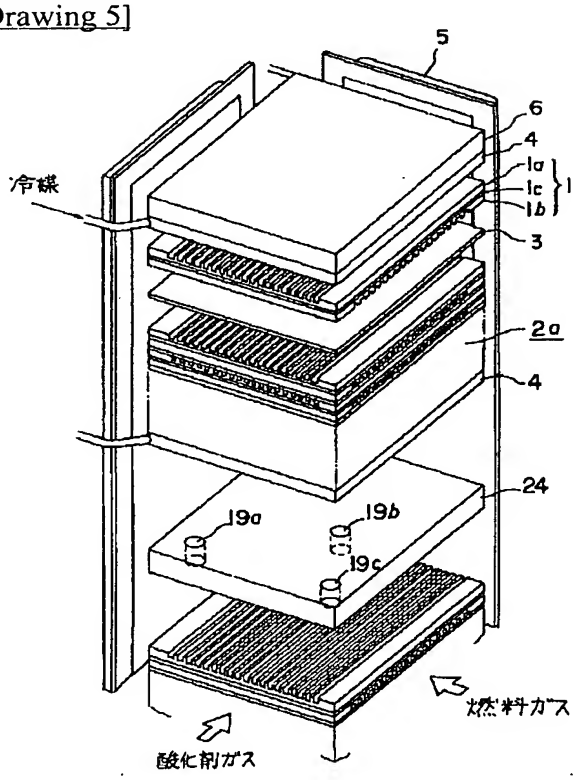

[Drawing 3]



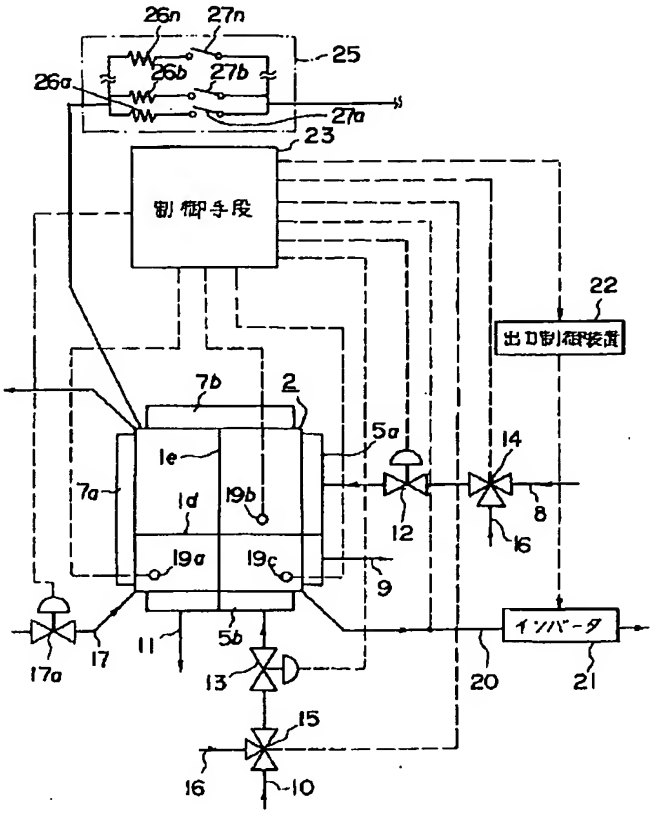

[Drawing 4]



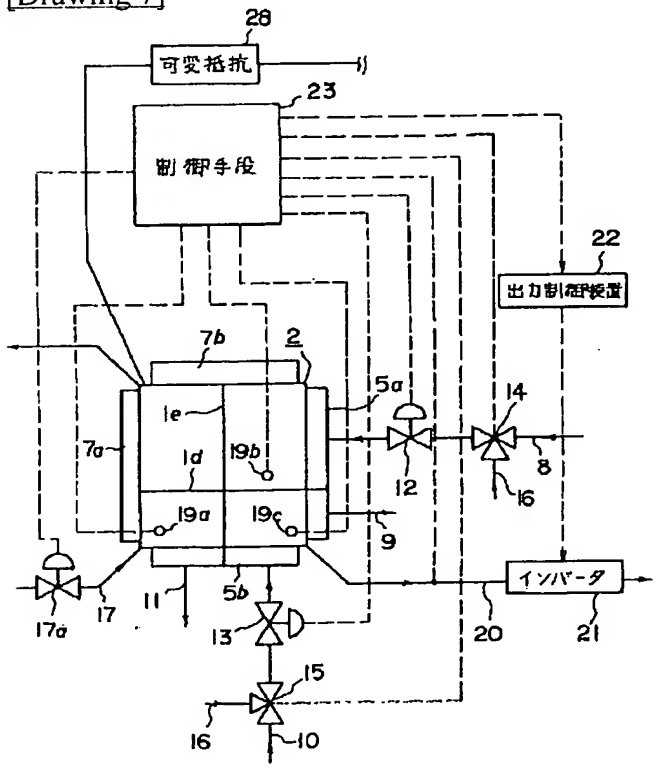

[Drawing 5]



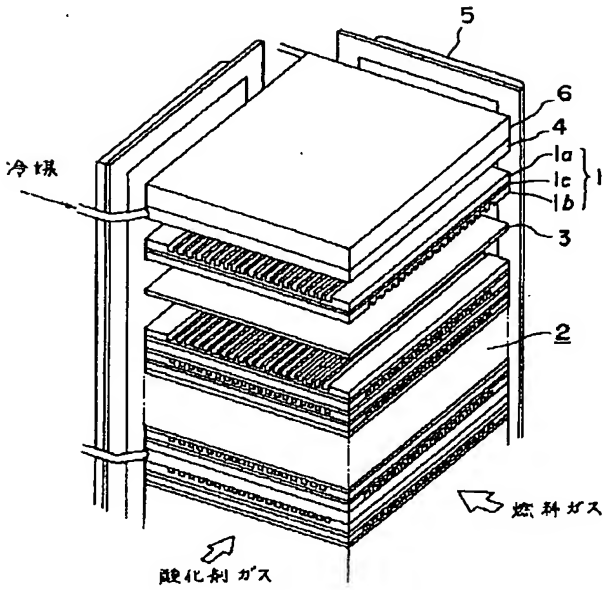

[Drawing 6]




[Drawing 7]




[Drawing 8]

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